

REMARKS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1-24 are pending in this application, Claims 22-24 having been added, Claim 1 having been presently amended; and Claims 5-16 and 18-20 having previously been withdrawn. Support for amended Claim 1 can be found, for example, in the original claims, drawings, and specification as originally filed.¹ No new matter is added.

In the outstanding Official Action, Claims 1 and 21 were rejected under 35 U.S.C. § 103(a) as unpatentable over Sportouch et al. (Thermoelectric Properties of Half-Heusler Phases: $\text{ErNi}_{1-x}\text{Cu}_x\text{Sb}$, $\text{YNi}_{1-x}\text{Cu}_x\text{Sb}$ and $\text{Zr}_x\text{Hf}_y\text{Ti}_z\text{NiSn}$, 18th International Conference on Thermoelectrics, 1999, pgs 344-347; hereinafter “Sportouch”) in view of Shen et al. (Synthesis and Sintering of ZrNiSn Thermoelectric Compounds, 21st International Conference on Thermoelectrics, August 25-29, 2002, pgs 166-169, hereinafter “Shen”); Claims 2-4 were rejected under 35 U.S.C. § 103(a) as unpatentable over Sportouch in view of Shen, further in view of Hohl et al. (Efficient dopants for ZrNiSn based thermoelectric materials, J. Phys.: Condens. Matter, 11, 1999, pgs 1697-1709; hereinafter “Hohl”); and Claim 17 was rejected under 35 U.S.C. § 103(a) as unpatentable over Sportouch in view of Shen, further in view of Bell (U.S. Patent No. 6,700,052).

Applicants acknowledge with appreciation the courtesy of Examiner Phasge in granting an interview in this case with Applicants’ representative on May 14, 2009, during which time the issues in the outstanding Office Action were discussed as substantially summarized hereinafter and also on the Interview Summary Sheet. The Examiner recommended that a Declaration under 37 CFR § 1.132 should be submitted with the

¹ See page 30, lines 14-27 of the specification.

response, which shows comparative results between the method used in Shen and the method used in the method of Claim 1.

In response the rejection of Claims 1 and 21 under 35 U.S.C. § 103(a) as unpatentable over Sportouch in view of Shen, Applicants respectfully submit that amended independent Claim 1 recites novel features clearly not taught or rendered obvious by the applied references.

Independent Claim 1 is directed to a:

...thermoelectric material which is a sintered body and represented by composition formula (1) and comprises as a major phase an MgAgAs crystal structure, *the sintered body being obtained by melting raw materials to obtain melted raw materials, quenching the melted raw materials to obtain an alloy formed of a metallic lump*, pulverizing the alloy to obtain an alloy powder, and monolithic molding the alloy powder by sintering, hot press or SPS method, wherein the composition formula (1) is $(\text{Ti}_{a1}\text{Zr}_{b1}\text{Hf}_{c1})_x\text{Ni}_y\text{Sn}_{100-x-y}$, and

a_1, b_1, c_1, x and y satisfy the conditions of: $0 < a_1 < 1$, $0 < b_1 < 1$, $0 < c_1 < 1$, $a_1+b_1+c_1=1$, $30 \leq x \leq 35$ and $30 \leq y \leq 35$,

and the sintered body has a dimensionless figure-of-merit ZT value of not less than 0.05 at 300° K.

Shen describes ZrNiSn-based half Heusler compounds crystallized in a cubic structure of the MgAgAs type, and that a spark plasma sintering technique is used to consolidate the ZrNiSn-based compounds.² However, Shen fails to teach or suggest that that the sintered body is “obtained by melting raw materials to obtain melted raw materials, quenching the melted raw materials to obtain an alloy formed of a metallic lump,” as in Claim 1. In fact, Shen does not appear to describe quenching at all.

In addition, Applicant respectfully submits that the method described in Claim 1 creates a thermoelectric material with superior thermoelectric characteristics than the material created by the method of Shen, as evidenced by the enclosed declaration under 37 C.F.R

² See page 166 of Shen.

§1.132. The Declaration states that a fine grain sized Ti powder, Zr powder, Hf powder, Ni powder, and Sn powder are prepared as raw materials, and when using these raw material metallic powders, a sintered body having the same composition as shown in Example I-9 of the present invention is obtained by the method of Shen. Page 166 of Shen describes that the method of Shen includes spark plasma sintering. The method of Shen **does not include** melting raw materials to obtain melted raw materials, ***quenching the melted raw materials to obtain an alloy formed of a metallic lump***, or pulverizing the alloy. Using the method of Shen, the dimensionless figure of merit ZT of the obtained sintered body at a temperature of 300° K (calculated in the same manner as described in the Applicants' embodiments) has a measured dimensionless figure of merit ZT value of 0.04.

However, as seen in Applicants' Table 1 on page 36 of the specification, the dimensionless figure of merit ZT value of the sintered body shown in Example I-9 of the Applicants' invention is 0.08. It is clear from page 30, lines 14-27 of the specification that Applicants' method includes melting raw materials to obtain melted raw materials, quenching the melted raw materials to obtain an alloy formed of a metallic lump, and pulverizing the alloy before sintering.

Thus, the dimensionless figure of merit ZT value of the sintered body obtained by the method of Shen is only half of that of the sintered body of an embodiment of Applicants' invention as shown in Example I-9. As a result, the sintered body obtained by the method of Shen is inferior to that of the present invention in thermoelectric characteristics, even if the composition of the sintered body of Shen has the same composition as the Applicants' sintered body.

Thus, Applicants respectfully submit that Shen fails to teach or suggest that the "sintered body has a dimensionless figure-of-merit ZT value of not less than 0.05 at 300° K" and "the sintered body being obtained by melting raw materials to obtain melted raw

materials, quenching the melted raw materials to obtain an alloy formed of a metallic lump," as recited in Claim 1.

Accordingly, Applicants respectfully request that the rejection of Claims 1 and 21 under 35 U.S.C. § 103 be withdrawn.

In response to the rejection of Claims 2-4 were rejected under 35 U.S.C. § 103(a) as unpatentable over Sportouch further in view of Hohl, Applicants note that Claims 2-4 are dependent on independent Claim 1 and are believed to be patentable for at least the reasons discussed above. Further, Applicants respectfully submit that Hohl fails to cure any of the above-noted deficiencies of Shen and Sportouch.

Accordingly, Applicants respectfully request the rejection of Claims 2-4 under 35 U.S.C. § 103(a) as unpatentable over Sportouch further in view of Hohl be withdrawn.

In response to the rejection of Claim 17 under 35 U.S.C. § 103(a) as unpatentable over Sportouch further in view of Bell, Applicants note that Claim 17 is dependent on Claim 1 and is thus believed to be patentable for at least the reasons discussed above. Further, Applicants respectfully submit that Bell fails to cure any of the above-noted deficiencies of Shen and Sportouch.

Accordingly, Applicants respectfully request the rejection of Claim 17 under 35 U.S.C. § 103(a) as unpatentable over Sportouch in view Shen and further in view of Bell be withdrawn.

In order to vary the scope of protection recited in the claims, new Claims 22-24 are added. New Claims 22-24 find non-limiting support in the disclosure as originally filed, for example at page 30, lines 14-27.

Therefore, the changes to the claims are not believed to raise a question of new matter.³

Consequently, in view of the present amendment, and in light of the above discussion, the pending claims as presented herewith are believed to be in condition for formal allowance, and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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³ See MPEP 2163.06 stating that "information contained in any one of the specification, claims or drawings of the application as filed may be added to any other part of the application without introducing new matter."